CLAIMS

WE CLAIM:

1. A MEMS structure comprising:

a substrate;

at least one conductive element that is in mechanical communication with the substrate and that extends therefrom;

a movable MEMS element having a portion that is free from the substrate and positioned such that a gap separates the movable MEMS element from the at least one conductive element;

at least one electrical trace having a first terminal end in electrical communication with the at least one conductive element and a second terminal end in electrical communication with a peripheral region; and

a cap attached to the substrate inside the peripheral region having upper and side walls that encapsulate the at least one conductive element and the movable MEMS element.

2. The MEMS structure as recited in claim 1, wherein the cap is non-conductive.

3. The MEMS structure as recited in claim 2, wherein the cap is selected from the group consisting of glass, high resistivity silicon, crystalline sapphire, and ceramic.

4. The MEMS structure as recited in claim 1, wherein the cap is conductive.

5. The MEMS structure as recited in claim 4, wherein the cap is selected from the group consisting of silicon and metal.

6. The MEMS structure as recited in claim 1, wherein the electrical trace is selected from the group consisting of doped polysilicon, and a metal

7. The MEMS structure as recited in claim 6, wherein the metal is selected from the group consisting of tungsten, titanium, nickel, and alloys thereof, and aluminum, copper, silver, and gold.

8. The MEMS structure as recited in claim 1, wherein a bottom surface of at least one of the side walls of the cap is attached to the substrate.

9. The MEMS structure as recited in claim 1, wherein the sidewalls are connected to the substrate at a location between first and second terminal ends of the at least one electrical trace.

10. The MEMS structure as recited in claim 1, wherein the at least one electrical trace is disposed within an interface between the at least one conductive MEMS element and the substrate.

11. The MEMS structure as recited in claim 10, wherein the interface prevents any portion of the at least one electrical trace from being in electrical communication with the substrate.

12. The MEMS structure as recited in claim 10 wherein the interface layer comprises an electrical insulator.

13. The MEMS structure as recited in claim 12 wherein the interface layer comprises one of silicon dioxide and silicon nitride.

14. The MEMS structure as recited in claim 1, wherein the substrate comprises a nonconductive material.

15. The MEMS structure as recited in claim 14, wherein a portion of the at least one electrical trace is in electrical communication with the substrate.

16. The MEMS structure as recited in claim 1, wherein the substrate comprises a conductive material.

17. The MEMS structure as recited in claim 1, wherein the substrate further comprises a recess formed in the upper surface thereof.

18. The MEMS structure as recited in claim 17, wherein the movable MEMS element is disposed above and substantially aligned with the recess.

19. The MEMS structure as recited in claim 1, wherein the movable MEMS element comprises at least one conductive member attached to a nonconductive base.

20. The MEMS structure as recited in claim 19, wherein the nonconductive base is selectively etchable from the conductive member.

21. The MEMS structure as recited in claim 19 wherein the nonconductive base comprises one of silicon dioxide and silicon nitride.

22. The MEMS structure as recited in claim 1, wherein the substrate is selected from the group consisting of high resistivity silicon, crystalline sapphire, glass and ceramic.

23. The MEMS structure as recited in claim 1, wherein the substrate is selected from the group consisting of silicon, silicon carbide, gallium arsenide, and metal.

24. The MEMS structure as recited in claim 1, wherein the at least one conductive element is selected from the group consisting of silicon, silicon carbide, and gallium arsenide.

25. A method for manufacturing a MEMS structure, comprising:

connecting a wafer to a substrate via an interface;

forming a channel within the interface having a first terminal end facing the wafer, and a second terminal end exposed to a peripheral region;

filling the recess with a conductive material;

etching the wafer so as to produce a stationary member in mechanical communication with the substrate via the interface and a movable member spaced from the stationary member via a gap; and

bonding a cap to the wafer so as to encapsulate the stationary and movable members.

26. The method as recited in claim 25, further comprising etching the interface so as to release the movable member from the substrate.

27. The method as recited in claim 26, further comprising forming a recess in an upper surface of the substrate so as to be substantially aligned with the movable member.

28. The method as recited in claim 25, wherein the filling step further comprises forming an electrical trace having a first terminal end in electrical communication with the stationary member and a second terminal end in electrical communication with a peripheral region.

29. The method as recited in claim 25, wherein the bonding step further comprises positioning the cap such that a portion of the cap is disposed between the first and second terminal ends.

30. The method as recited in claim 25, further comprising:

providing a blank having a plurality of caps disposed therein;

bonding the blank to the wafer; and

dicing the combined blank and wafer in a single operation to yield encapsulated devices.

31. A MEMS structure disposed within a peripheral region comprising:

a substrate;

a movable MEMS element having a distal end in mechanical communication with the substrate, and a middle portion disposed its two distal ends free from the substrate; and

a cap attached to the substrate having upper and side walls that encapsulate the at least one conductive element and the movable MEMS element.

32. The MEMS structure as recited in claim 31, wherein the cap separates the MEMS structure from the peripheral region, the MEMS structure further comprising:

a stationary MEMS element in mechanical communication with the substrate and disposed adjacent the movable MEMS element; and

at least one electrical trace having a first terminal end in electrical communication with the at least one stationary element and a second terminal end in electrical communication with the peripheral region.

33. The MEMS structure as recited in claim 32, further comprising:

a second stationary MEMS element in mechanical communication with the substrate and disposed adjacent the movable MEMS element; and

a second electrical trace having a first terminal end in electrical communication with the second stationary MEMS element and a second terminal end in electrical communication with the peripheral region.

34. The MEMS structure as recited in claim 33, wherein the stationary MEMS elements are electrically isolated from each other.

35. The MEMS structure as recited in claim 32, wherein the stationary MEMS element is conductive.

36. The MEMS structure as recited in claim 31, wherein the movable MEMS element further comprises at least two conductive elements.

37. The MEMS structure as recited in claim 36, wherein the at least two conductive elements are electrically isolated from each other.

38. A MEMS structure surrounded by a peripheral region, the MEMS structure comprising:

a substrate;

at least one stationary element that is in mechanical communication with the substrate;

a movable MEMS element disposed adjacent the conductive element, and having a distal end in mechanical communication with the substrate, and a middle portion disposed between its two distal ends free from the substrate; and

at least one electrical trace having a first terminal end in electrical communication with the at least one stationary element and a second terminal end in electrical communication with the peripheral region.

39. The MEMS structure as recited in claim 38, further comprising a cap attached to the substrate inside the peripheral region having upper walls and side walls that encapsulate the at least one conductive element and the movable MEMS element.

40. The MEMS structure as recited in claim 39, wherein the second terminal extends outside the cap

41. A MEMS structure surrounded by a peripheral region, the MEMS structure comprising:

a substrate;

a first and second stationary elements in mechanical communication with the substrate;

a movable MEMS element disposed adjacent the conductive element, and having a distal end in mechanical communication with the substrate, and a middle portion disposed between its two distal ends free from the substrate; and

a first and second electrical trace having first terminal ends in electrical communication with the first and second stationary elements, respectively, and having second terminal ends in electrical communication with the peripheral region.

42. The MEMS structure as recited in claim 41, further comprising a cap attached to the substrate inside the peripheral region having upper walls and side walls that encapsulate the at least two conductive elements and the movable MEMS element.

43. The MEMS structure as recited in claim 42, wherein the second terminal ends extend outside the cap.

44. The MEMS structure as recited in claim 43, wherein the second terminal ends are electrically isolated from each other.

45. The MEMS structure as recited in claim 41, wherein the movable MEMS element further comprises at least two conductive elements.

46. The MEMS structure as recited in claim 45, wherein the at least two conductive elements are electrically isolated from each other.